(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 926 782 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
12.07.2023 Bulletin 2023/28

(21) Application number: **20911646.6**

(22) Date of filing: **29.10.2020**

(51) International Patent Classification (IPC):
H02J 3/38 *(2006.01)* ***H02J 13/00*** *(2006.01)*
H02S 50/10 *(2014.01)*

(52) Cooperative Patent Classification (CPC):
H02J 3/381; H02J 13/00002; H02S 50/10;
H02J 2300/24; Y02E 40/70; Y02E 60/00;
Y04S 10/123; Y04S 10/30; Y04S 40/124

(86) International application number:
PCT/CN2020/124773

(87) International publication number:
WO 2021/139348 (15.07.2021 Gazette 2021/28)

(54) **METHOD AND APPARATUS FOR OBTAINING POSITION INFORMATION OF CONTROLLER**

VERFAHREN UND VORRICHTUNG ZUR GEWINNUNG VON POSITIONSINFORMATIONEN EINES STEUERGERÄTES

PROCÉDÉ ET APPAREIL D'OBTENTION D'INFORMATIONS DE POSITION D'UN DISPOSITIF DE COMMANDE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **08.01.2020 CN 202010018099**

(43) Date of publication of application:
22.12.2021 Bulletin 2021/51

(73) Proprietor: **Huawei Digital Power Technologies Co., Ltd.**
Shenzhen, Guangdong 518043 (CN)

(72) Inventors:
- **MA, Xun**
  Shenzhen, Guangdong 518129 (CN)
- **SUN, Yu**
  Shenzhen, Guangdong 518129 (CN)
- **SHUI, Wei**
  Shenzhen, Guangdong 518129 (CN)

(74) Representative: **Maiwald GmbH**
Elisenhof
Elisenstraße 3
80335 München (DE)

(56) References cited:
CN-A- 103 036 944
CN-A- 107 769 250
CN-A- 108 964 262
CN-A- 109 905 084
CN-A- 111 245 007
KR-A- 20160 135 127
US-A1- 2006 162 772
US-A1- 2013 342 389
US-A1- 2017 070 051
US-A1- 2018 278 207

EP 3 926 782 B1

Description

TECHNICAL FIELD

[0001] This application relates to the field of solar energy, and in particular, to a method and apparatus for obtaining location information of a controller.

BACKGROUND

[0002] Solar energy is becoming increasingly popular by virtue of no pollution, zero emission, and the like. A solar photovoltaic power generation system (which is also referred to as a photovoltaic system) includes an inverter and a photovoltaic module. Because a voltage of photovoltaic modules that are connected in series is quite high, when a dangerous situation such as a fire occurs, the voltage of a photovoltaic string obtained after the photovoltaic modules are connected in series needs to be reduced, to ensure personal safety. In this case, a controller (which is an optimizer or a shutdown device) configured to control a photovoltaic module is generated for the solar photovoltaic power generation system. A function of the controller is to perform DC-DC conversion on a direct current output by the photovoltaic module, to output a direct current whose voltage and current are adjustable. In this way, a maximum power point of the photovoltaic module can be tracked.

[0003] The solar photovoltaic power generation system includes a high-voltage direct current string and the inverter. The high-voltage direct current string includes a plurality of photovoltaic units, and one photovoltaic unit includes the photovoltaic module and the controller. In the solar photovoltaic power generation system, information is transmitted between the inverter and the controller through power-line communication (power-line communication, PLC). The inverter is a PLC central coordinator, and the controller is a PLC station. The inverter and the controller perform information interactions such as service query and command control through the PLC. After the high-voltage direct current string and the inverter are installed and deployed, sequence number code of controllers under a same high-voltage direct current string and location information of the photovoltaic unit on which the controller is located need to be correspondingly stored for ease of management. An absolute physical location of the photovoltaic unit may be obtained based on the location information and a detailed engineering design.

[0004] In a current technology, after a solar photovoltaic power generation system is installed, location information of photovoltaic units on which controllers are located is manually recorded in sequence and imported into a management system. This is inefficient and error-prone. United States patent application US 2013/0342389 A1 discloses a photovoltaic (PV) panel that can be used in a PV installation to provide a map of locations of individual PV panels, based on, e.g., radio frequency signals or by tracking an obstruction, such as a cloud. United States patent application US 2006/0162772 A1 discloses a system and a method for monitoring photovoltaic power generation systems or arrays. Panels communicate with one another via wired transceivers, wireless transceivers, optical or opto-electronic communications. United States patent application US 2017/0070051 A1 discloses an array of installed energy harvesting devices, wherein location information is obtained from GPS coordinates.

SUMMARY

[0005] This application provides a method and apparatus for obtaining location information of a controller, to obtain location information of a controller in a high-voltage direct current string in a photovoltaic system. This saves labor and improves installation efficiency and operation and maintenance efficiency. In principle, aspects of the invention are disclosed in independent claims 1, 8, 15 and 16.

[0006] According to a first aspect, this application provides a method for obtaining location information of a controller, including:

An inverter obtains signal feature information of each photovoltaic unit in a high-voltage direct current string, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, and the another photovoltaic unit is a photovoltaic unit other than a photovoltaic unit corresponding to the communication identifier of the photovoltaic unit. For example, one high-voltage direct current string includes 24 photovoltaic units, and signal feature information of a photovoltaic unit 1 includes a communication identifier of the photovoltaic unit 1 and signal features of the other 23 photovoltaic units other than the photovoltaic unit 1. The signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter or one photovoltaic unit in the high-voltage direct current string, or a signal feature obtained when the any photovoltaic unit broadcasts, and the photovoltaic unit includes one controller and at least one photovoltaic module.

[0007] The inverter determines an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units.

[0008] The inverter determines relative installation location information of each photovoltaic unit based on relative

installation location information of a target photovoltaic unit in the high-voltage direct current string and the installation sequence of all the photovoltaic units, where the target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string.

[0009] According to the method for obtaining location information of a controller in the first aspect, the inverter obtains the signal feature information of each photovoltaic unit in the high-voltage direct current string, where the signal feature information of a photovoltaic unit includes the communication identifier of the photovoltaic unit, a communication identifier of another photovoltaic unit, and the signal feature corresponding to the another photovoltaic unit; the inverter determines the installation sequence of all photovoltaic units based on the signal feature information of all the photovoltaic units; and the inverter determines the relative installation location information of each photovoltaic unit based on the relative installation location information of the target photovoltaic unit in the high-voltage direct current string and the installation sequence of all photovoltaic units. The relative installation location information of each photovoltaic unit is determined, and location information of a controller of each photovoltaic unit is also determined correspondingly. The relative installation location information of the target photovoltaic unit in the high-voltage direct current string may be manually obtained and then pre-stored in the inverter, or obtained by the inverter, so that the location information of the controller in the high-voltage direct current string in a photovoltaic system may be obtained full-automatically or semi-automatically. This saves labor and improves installation efficiency and operation and maintenance efficiency.

[0010] In a possible design, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter, and that an inverter obtains signal feature information of each photovoltaic unit in a high-voltage direct current string includes:

[0011] The inverter communicates with each photovoltaic unit in the high-voltage direct current string in sequence;

the inverter sends a location positioning request to each photovoltaic unit in the high-voltage direct current string in sequence; and

the inverter receives the signal feature information sent by each photovoltaic unit after each photovoltaic unit receives the location positioning request.

[0012] According to the method for obtaining location information of a controller in this implementation, the inverter communicates with each photovoltaic unit in the high-voltage direct current string in sequence, where each photovoltaic unit stores a signal feature obtained when another photovoltaic unit communicates with the inverter, and the signal feature may be one of signal strength, signal attenuation, or signal impedance; the inverter sends the location positioning request to each photovoltaic unit in sequence; and the inverter receives the signal feature information sent by each photovoltaic unit after each photovoltaic unit receives the location positioning request. Therefore, the signal feature information of each photovoltaic unit may be obtained in a unicast manner.

[0013] In a possible design, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter, and that an inverter obtains signal feature information of each photovoltaic unit in a high-voltage direct current string includes:

[0014] The inverter communicates with each photovoltaic unit in the high-voltage direct current string in sequence;

the inverter broadcasts a location positioning request to each photovoltaic unit in the high-voltage direct current string; and

the inverter receives the signal feature information sent in sequence by each photovoltaic unit.

[0015] According to the method for obtaining location information of a controller in this implementation, the inverter communicates with each photovoltaic unit in the high-voltage direct current string in sequence, where each photovoltaic unit stores a signal feature obtained when another photovoltaic unit communicates with the inverter, and the signal feature may be one of signal strength, signal attenuation, or signal impedance; the inverter broadcasts the location positioning request to each photovoltaic unit in the high-voltage direct current string; and the inverter receives the signal feature information sent in sequence by each photovoltaic unit. Therefore, the signal feature information of each photovoltaic unit may be obtained in a broadcast manner.

[0016] According to the method, that the inverter determines an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units includes:

[0017] The inverter determines a photovoltaic unit adjacent to each photovoltaic unit in sequence and based on the signal feature information of all the photovoltaic units; and

the inverter performs sequencing, based on the photovoltaic unit adjacent to each photovoltaic unit and a communication identifier of each photovoltaic unit, to obtain the installation sequence of all the photovoltaic units.

[0018] In a possible design, the method further includes:

the inverter obtains the relative installation location information of the target photovoltaic unit in the high-voltage direct current string.

[0019] In a possible design, that the inverter obtains the relative installation location information of the target photovoltaic unit in the high-voltage direct current string includes:
The inverter communicates with the target photovoltaic unit under a first condition, where the first condition is any one of disconnecting a direct current input switch of the inverter, disconnecting a positive electrode of the high-voltage direct current string, and disconnecting a negative electrode of the high-voltage direct current string; and

the inverter determines the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit; or
the inverter determines the relative installation location information of the target photovoltaic unit based on a signal feature of the target photovoltaic unit that is received before the first condition is executed and a signal feature of the target photovoltaic unit that is received after the first condition is executed.

[0020] According to the method for obtaining location information of a controller provided in this implementation, the inverter communicates with the target photovoltaic unit under the first condition; and determines the relative installation location information of the target photovoltaic unit based on the received signal feature of the target photovoltaic unit; or determines the relative installation location information of the target photovoltaic unit based on the signal feature of the target photovoltaic unit that is received before the first condition is executed and the signal feature of the target photovoltaic unit that is received after the first condition is executed. Therefore, the relative installation location information of the target photovoltaic unit in the high-voltage direct current string may be obtained automatically.

[0021] In a possible design, the relative installation location information of the target photovoltaic unit in the high-voltage direct current string is pre-stored in the inverter.

[0022] According to the method for obtaining location information of a controller in this implementation, the relative installation location information of the target photovoltaic unit in the high-voltage direct current string is manually obtained and then pre-stored in the inverter.

[0023] In a possible design, the method further includes:

The inverter obtains signal feature information of each photovoltaic unit in a solar photovoltaic power generation system, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, the another photovoltaic unit is a photovoltaic unit other than a photovoltaic unit corresponding to the communication identifier of the photovoltaic unit, and the signal feature is a signal feature obtained when any photovoltaic unit in the solar photovoltaic power generation system communicates with the inverter or one photovoltaic unit in the solar photovoltaic power generation system, or a signal feature obtained when the any photovoltaic unit broadcasts; and
The inverter determines, based on signal feature information of all photovoltaic units and according to a grouping rule, a quantity of high-voltage direct current strings included in the solar photovoltaic power generation system and a high-voltage direct current string to which each photovoltaic unit belongs, where the grouping rule is that photovoltaic units adjacent to a photovoltaic unit in a same high-voltage direct current string may be determined based on the signal feature information of the photovoltaic units.

[0024] According to the method for obtaining location information of a controller in this implementation, the quantity of high-voltage direct current strings included in the solar photovoltaic power generation system and the high-voltage direct current string to which each photovoltaic unit belongs may be determined.

[0025] According to a second aspect, this application provides an apparatus for obtaining location information of a controller, including: a first obtaining module, a first determining module, and a second determining module.

[0026] The first obtaining module is configured to obtain signal feature information of each photovoltaic unit in a high-voltage direct current string, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, and the another photovoltaic unit is a photovoltaic unit other than a photovoltaic unit corresponding to the communication identifier of the photovoltaic unit. For example, one high-voltage direct current string includes 24 photovoltaic units, and signal feature information of a photovoltaic unit 1 includes a communication identifier of the photovoltaic unit 1 and signal features of the other 23 photovoltaic units other than the photovoltaic unit 1. The signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with an inverter or one photovoltaic unit in the high-voltage direct current string, or a signal feature obtained when the any photovoltaic unit broadcasts, and the photovoltaic unit includes one controller and at least one photovoltaic module.

[0027] The first determining module is configured to determine an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units.

[0028] The second determining module is configured to determine relative installation location information of each photovoltaic unit based on relative installation location information of a target photovoltaic unit in the high-voltage direct

current string and the installation sequence of all the photovoltaic units, where the target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string.

[0029] In a possible design, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter, and the first obtaining module is configured to:

communicate with each photovoltaic unit in the high-voltage direct current string in sequence;
send a location positioning request to each photovoltaic unit in the high-voltage direct current string in sequence; and
receive the signal feature information sent by each photovoltaic unit after each photovoltaic unit receives the location positioning request.

[0030] In a possible design, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter, and the first obtaining module is configured to:

communicate with each photovoltaic unit in the high-voltage direct current string in sequence;
broadcast a location positioning request to each photovoltaic unit in the high-voltage direct current string; and
receive the signal feature information sent in sequence by each photovoltaic unit.

[0031] The first determining module is configured to:

determine a photovoltaic unit adjacent to each photovoltaic unit in sequence and based on the signal feature information of all photovoltaic units; and
perform sequencing based on the photovoltaic unit adjacent to each photovoltaic unit and a communication identifier of each photovoltaic unit, to obtain the installation sequence of all photovoltaic units.

[0032] In a possible design, the first obtaining module is further configured to:
obtain the relative installation location information of the target photovoltaic unit in the high-voltage direct current string.

[0033] In a possible design, the first obtaining module is configured to:

communicate with the target photovoltaic unit under a first condition, where the first condition is any one of disconnecting a direct current input switch of the inverter, disconnecting a positive electrode of the high-voltage direct current string, and disconnecting a negative electrode of the high-voltage direct current string; and
determine the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit; or
determine the relative installation location information of the target photovoltaic unit based on a signal feature of the target photovoltaic unit that is received before the first condition is executed and a signal feature of the target photovoltaic unit that is received after the first condition is executed.

[0034] In a possible design, the relative installation location information of the target photovoltaic unit in the high-voltage direct current string is pre-stored in the inverter.

[0035] In a possible design, the apparatus further includes:

a second obtaining module, configured to obtain signal feature information of each photovoltaic unit in a solar photovoltaic power generation system, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, and the signal feature is a signal feature obtained when any photovoltaic unit in the solar photovoltaic power generation system communicates with the inverter or one photovoltaic unit in the solar photovoltaic power generation system, or a signal feature obtained when the any photovoltaic unit broadcasts; and
a third determining module, configured to determine, based on signal feature information of all photovoltaic units and according to a grouping rule, a quantity of high-voltage direct current strings included in the solar photovoltaic power generation system and a high-voltage direct current string to which each photovoltaic unit belongs, where the grouping rule is that photovoltaic units adjacent to a photovoltaic unit in a same high-voltage direct current string may be determined based on the signal feature information of the photovoltaic units.

[0036] For beneficial effects of the apparatus for obtaining location information of a controller in the second aspect and the possible designs of the second aspect, refer to beneficial effects brought by the first aspect and the possible implementations of the first aspect. Details are not described herein again.

[0037] According to a third aspect, this application provides a device, including:

a processor; and
a memory, configured to store executable instructions of the processor, where
the processor is configured to perform, by executing the executable instructions, the method for obtaining location information of a controller in any one of the first aspect and the possible designs of the first aspect.

[0038] According to a fourth aspect, this application provides a readable storage medium. The readable storage medium stores executable instructions. When at least one processor of a device executes the executable instructions, the device performs the method for obtaining location information of a controller in any one of the first aspect and the possible designs of the first aspect.

[0039] According to a fifth aspect, this application provides a program product. The program product includes executable instructions, and the executable instructions are stored in a readable storage medium. At least one processor of a device may read the executable instructions from the readable storage medium, and the at least one processor executes the executable instructions, so that the device performs the method for obtaining location information of a controller in any one of the first aspect and the possible designs of the first aspect.

[0040] According to a sixth aspect, this application provides a chip. The chip is connected to a memory, or a memory is integrated into the chip. When a software program stored in the memory is executed, the method for obtaining location information of a controller in any one of the first aspect and the possible designs of the first aspect is implemented.

BRIEF DESCRIPTION OF DRAWINGS

[0041]

FIG. 1 is a schematic structural diagram of a solar photovoltaic power generation system;
FIG. 2 is a flowchart of an embodiment of a method for obtaining location information of a controller according to this application;
FIG. 3 is a schematic diagram of a signal feature according to this application;
FIG. 4 is a flowchart of an embodiment of a method for obtaining location information of a controller according to this application;
FIG. 5 is a schematic structural diagram of an embodiment of an apparatus for obtaining location information of a controller according to this application;
FIG. 6 is a schematic structural diagram of an embodiment of an apparatus for obtaining location information of a controller according to this application; and
FIG. 7 is a schematic structural diagram of a device according to this application.

DESCRIPTION OF EMBODIMENTS

[0042] In embodiments of this application, a word such as "example" or "for example" is used to give an example, an illustration, or descriptions. Any embodiment or scheme described as "example" or "for example" in the embodiments of this application should not be explained as being more preferred or having more advantages than another embodiment or scheme. Exactly, use of the word such as "example" or "for example" is intended to present a related concept in a specific manner.

[0043] In description of this application, it should be noted that terms "first" and "second" are merely intended for a purpose of description, and shall not be understood as an indication or implication of relative importance. "At least one" means one or more, and "a plurality of" means two or more.

[0044] First, the following describes some terms in the embodiments of this application, to facilitate understanding of a person skilled in the art.

1. An inverter is a power supply for DC-to-AC conversion, that is, converting a direct current of a photovoltaic PV module into an alternating current.
2. A controller has at least one of a shutdown function, a monitoring function, and an optimization function. A controller with the optimization function is referred to as an optimizer, and the optimizer is a power supply for DC-to-DC conversion, that is, converting a direct current of a photovoltaic PV module into an adjustable direct current. A controller with the shutdown function is referred to as a shutdown device, and the shutdown device is an output device that can shut down a photovoltaic PV module.
3. A photovoltaic unit includes a controller and at least one photovoltaic module.

[0045] A solar photovoltaic power generation system includes a high-voltage direct current string and an inverter, where the high-voltage direct current string includes a plurality of photovoltaic units, and a photovoltaic unit includes a

photovoltaic module and a controller. After actual installation and deployment, sequence number code of the controller under the same high-voltage direct current string and location information of the photovoltaic unit on which the controller is located need to be correspondingly stored for ease of management. In a current technology, location information of photovoltaic units on which controllers are located is manually recorded in sequence and imported into a management system. This is inefficient and error-prone. To resolve this problem, this application provides a method and apparatus for obtaining location information of a controller. After a solar photovoltaic power generation system is installed, under a preset frequency band, an inverter obtains signal feature information of each photovoltaic unit in a high-voltage direct current string, where the signal feature information includes a communication identifier of a current photovoltaic unit, a communication identifier of another photovoltaic unit, and a signal feature corresponding to the another photovoltaic unit; determines an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units; and determines relative installation location information of each photovoltaic unit based on relative installation location information of a target photovoltaic unit in the high-voltage direct current string and the installation sequence of all the photovoltaic units. The relative installation location information of each photovoltaic unit is determined, and relative installation location information of a controller of each photovoltaic unit is also determined correspondingly. The relative installation location information of the target photovoltaic unit in the high-voltage direct current string may be manually obtained and then pre-stored in the inverter, or obtained by the inverter, so that the location information of the controller in the high-voltage direct current string in the photovoltaic system may be obtained full-automatically or semi-automatically. This saves labor and improves installation efficiency and operation and maintenance efficiency. The following describes in detail a specific procedure of the method for obtaining location information of a controller according to this application with reference to the accompanying drawings.

[0046] FIG. 1 is a schematic structural diagram of a solar photovoltaic power generation system. The method for obtaining location information of a controller provided in this application may be applied to the solar photovoltaic power generation system shown in FIG. 1. The solar photovoltaic power generation system includes at least one high-voltage direct current string and an inverter. In FIG. 1, one direct current high-voltage string is used as an example for description. As shown in FIG. 1, the solar photovoltaic power generation system includes a high-voltage direct current string 4 and an inverter 3. The high-voltage direct current string 4 is connected to the inverter 3, at least one photovoltaic module 1 uses one controller 2, one photovoltaic unit includes the photovoltaic module 1 and the controller 2, and outputs of controllers 2 are connected in series to form the high-voltage direct current string 4. In FIG. 1, the high-voltage direct current string 4 includes 24 photovoltaic units. In the solar photovoltaic power generation system, information is transmitted between the inverter 3 and the controller 2 through PLC. The inverter 3 is a PLC central coordinator, and the controller 2 is a PLC station. Information exchange such as service query and command control between the inverter 3 and the controller 2 is performed through the PLC. FIG. 1 shows location information of photovoltaic units from a positive electrode of the high-voltage direct current string to a negative electrode of the high-voltage direct current string, that is, 1#, 2#, ..., and 24#, which is location information of the controllers. For example, a PLC network starts a function of obtaining location information of the controller in response to a received instruction from an upper-level device or automatically based on a current working status of the system. The function of obtaining location information of the controller may be started after PLC networking and high-voltage direct current string grouping are completed, or may be started when actually required. This is not limited in this embodiment of this application. This application may further be applied to another security protection system based on the PLC.

[0047] FIG. 2 is a flowchart of an embodiment of a method for obtaining location information of a controller according to this application. As shown in FIG. 2, the method in this embodiment may include the following steps.

[0048] S101: An inverter obtains signal feature information of each photovoltaic unit in a high-voltage direct current string, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter or one photovoltaic unit in the high-voltage direct current string, or a signal feature obtained when the any photovoltaic unit broadcasts, and the photovoltaic unit includes one controller and at least one photovoltaic module.

[0049] Specifically, S101 may be performed under a preset communication frequency band. The preset communication frequency band may not be a current communication frequency band, different communication frequency bands have different radiation to external space and different distribution capacitance to the ground, and the preset communication frequency band is set to better distinguish signal features of different photovoltaic units. The signal feature is one of signal strength, signal attenuation, or signal impedance.

[0050] Under the preset communication frequency band, the inverter communicates with each photovoltaic unit in the high-voltage direct current string. Specifically, the inverter communicates with each photovoltaic unit through PLC, and further obtains the signal feature information of each photovoltaic unit, where the signal feature information of a photovoltaic unit includes a communication identifier of any photovoltaic unit in the high-voltage direct current string and a signal feature of another photovoltaic unit. For example, the high-voltage direct current string includes 6 photovoltaic units, and signal feature information sent by a photovoltaic unit 1 is shown in Table 1.

Communication identifier of the photovoltaic unit 1	Communication identifier of a photovoltaic unit 2	Signal feature 1
	Communication identifier of a photovoltaic unit 3	Signal feature 2
	Communication identifier of a photovoltaic unit 4	Signal feature 3
	Communication identifier of a photovoltaic unit 5	Signal feature 4
	Communication identifier of a photovoltaic unit 6	Signal feature 5

[0051] The communication identifier of the photovoltaic unit may be a media access control (media access control, MAC) address or a logical address of the photovoltaic unit, or may be another communication address.

[0052] One photovoltaic unit includes one controller and at least one photovoltaic module, and the controller may be an optimizer or a shutdown device.

[0053] In an implementation, when the signal feature of the photovoltaic unit is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter, and that an inverter obtains signal feature information of each photovoltaic unit in a high-voltage direct current string may specifically be:

S1011: The inverter communicates with each photovoltaic unit in the high-voltage direct current string in sequence.

[0054] Specifically, the inverter may communicate with each photovoltaic unit in the high-voltage direct current string in sequence under the preset communication frequency band. For example, the inverter sends a communication request to a first photovoltaic unit, and after receiving the communication request, the first photovoltaic unit sends information to the inverter. In this case, another photovoltaic unit stores a signal feature that is received when the first photovoltaic unit communicates with the inverter. Then, similarly, the inverter sends a communication request to a second photovoltaic unit, and after receiving the communication request, the second photovoltaic unit sends information to the inverter. In this case, another photovoltaic unit stores a signal feature that is received when the second photovoltaic unit communicates with the inverter. Similarly, when the inverter sends a communication request to an N^{th} photovoltaic unit, where N is a total quantity of photovoltaic units, after receiving the communication request, the N^{th} photovoltaic unit sends information to the inverter. In this case, another photovoltaic unit stores a signal feature that is received when the N^{th} photovoltaic unit communicates with the inverter. If the high-voltage direct current string includes N photovoltaic units, each photovoltaic unit stores (N-1) signal features, and correspondingly stores communication identifiers of the photovoltaic units during storage.

[0055] S1012: The inverter sends a location positioning request to each photovoltaic unit in the high-voltage direct current string in sequence.

[0056] S1013: The inverter receives the signal feature information sent by each photovoltaic unit after each photovoltaic unit receives the location positioning request.

[0057] After S1011, each photovoltaic unit stores a signal feature obtained when another photovoltaic unit communicates with the inverter, and then the inverter sends a location positioning request to each photovoltaic unit, to obtain the signal feature that is stored in each photovoltaic unit and that is obtained when another photovoltaic unit communicates with the inverter, that is, obtain the signal feature information of each photovoltaic unit.

[0058] In another implementation, that an inverter obtains signal feature information of each photovoltaic unit in a high-voltage direct current string may specifically be:

S1011': The inverter communicates with each photovoltaic unit in the high-voltage direct current string in sequence.

[0059] For details, refer to the description in S1011. Details are not described herein again.

[0060] S1012': The inverter broadcasts a location positioning request to each photovoltaic unit in the high-voltage direct current string in sequence.

[0061] S1013': The inverter receives the signal feature information sent in sequence by each photovoltaic unit.

[0062] After S1011', each photovoltaic unit stores a signal feature obtained when another photovoltaic unit communicates with the inverter, and then the inverter broadcasts the location positioning request to each photovoltaic unit. When the location positioning request is broadcast, a preset interval may further be carried, that is, an interval at which each photovoltaic unit sends the signal feature information in sequence. For example, a first photovoltaic unit first sends signal feature information. When the first photovoltaic unit communicates with the inverter, a second photovoltaic unit may receive a signal feature of communication, and send the signal feature information to the inverter after the preset interval, and so on, until an N^{th} photovoltaic unit sends signal feature information to the inverter.

[0063] When the signal feature of the photovoltaic unit is a signal feature obtained when the photovoltaic unit communicates with a photovoltaic unit in the high-voltage direct current string, a photovoltaic unit is replaced with an inverter to perform S1011 or S1011', and then the inverter performs S1012 and S1013 or S1012' and S1013', to obtain the signal feature information of each photovoltaic unit in the high-voltage direct current string.

[0064] When the signal feature of the photovoltaic unit is a signal feature obtained when any photovoltaic unit broadcasts, and when a photovoltaic unit broadcasts, another photovoltaic stores the received signal feature obtained when the photovoltaic unit broadcasts, and then the inverter performs S1012 and S1013 or S1012' and S1013', to obtain the signal feature information of each photovoltaic unit in the high-voltage direct current string.

[0065] S102: The inverter determines an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units.

[0066] Specifically, that the inverter determines an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units may specifically be:

S1021: The inverter determines a photovoltaic unit adjacent to each photovoltaic unit in sequence and based on the signal feature information of all the photovoltaic units.

[0067] Specifically, the signal feature information includes a communication identifier of a current photovoltaic unit and a signal feature obtained when another photovoltaic unit communicates with the inverter. For each photovoltaic unit, two photovoltaic units with strongest signal features, that is, photovoltaic units adjacent to the photovoltaic unit, are first determined from signal features of other photovoltaic units.

[0068] Specifically, a fifth photovoltaic unit shown in FIG. 1 is used as an example for description. FIG. 3 is a schematic diagram of a signal feature according to this application. As shown in FIG. 3, photovoltaic units adjacent to the fifth photovoltaic unit are photovoltaic units 4# and 6#. When the fifth photovoltaic unit sends information to the inverter, signals are coupled, and then transmitted along the photovoltaic units 4# and 6# respectively. Some signals reach to the ground after passing through a photovoltaic module, namely, a distributed capacitance to the ground 5, and some signals are radiated to the space. Signals continue to be transmitted to photovoltaic units 3# and 7#. Because signals are lost in another way, the photovoltaic units 4# and 6# that are adjacent to the fifth photovoltaic unit have strongest sampling signals and strongest signal features.

[0069] S1022: The inverter performs sequencing, based on the photovoltaic unit adjacent to each photovoltaic unit and a communication identifier of each photovoltaic unit, to obtain the installation sequence of all the photovoltaic units.

[0070] Specifically, the high-voltage direct current string shown in FIG. 1 is used as an example. After S1022, the installation sequence of all the photovoltaic units may be obtained, that is, a first photovoltaic unit, a second photovoltaic unit, ..., and an N^{th} photovoltaic unit.

[0071] S103: The inverter determines relative installation location information of each photovoltaic unit based on relative installation location information of a target photovoltaic unit in the high-voltage direct current string and the installation sequence of all the photovoltaic units, where the target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string.

[0072] The target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string, may be a first photovoltaic unit or a last photovoltaic unit in the high-voltage direct current string, or may be at least one photovoltaic unit adjacent to a first photovoltaic unit, or may be at least one photovoltaic unit adjacent to a last photovoltaic unit. To be specific, the installation sequence of all the photovoltaic units may be determined. The relative installation location information of each photovoltaic unit may be obtained based on relative installation location information of at least one photovoltaic unit in the high-voltage direct current string and the installation sequence of all the photovoltaic units, to obtain location information of a controller of each photovoltaic unit. In a networking process, the inverter learns of a communication identifier of each photovoltaic unit and sequence number code of the controller of the photovoltaic unit. After the location information of the controller of each photovoltaic unit is obtained by using the method provided in this application, the sequence number code and the location information of the controller of each photovoltaic unit may be obtained. This saves labor and improves installation efficiency and operation and maintenance efficiency.

[0073] In an implementation, the relative installation location information of the target photovoltaic unit in the high-voltage direct current string is pre-stored in the inverter. The relative installation location information of the target photovoltaic unit may be manually obtained and then pre-stored in the inverter. This may be referred to as a semi-automatic manner.

[0074] In an implementation, before S101, the method in this embodiment may further include the following step.

[0075] S104: The inverter obtains the relative installation location information of the target photovoltaic unit in the high-voltage direct current string.

[0076] Specifically, S104 may be as follows: The inverter communicates with the target photovoltaic unit under a first condition, where the first condition is any one of disconnecting a direct current input switch of the inverter, disconnecting a positive electrode of the high-voltage direct current string, and disconnecting a negative electrode of the high-voltage direct current string; and

the inverter determines the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit; or
the inverter determines the relative installation location information of the target photovoltaic unit based on a signal feature of the target photovoltaic unit that is received before the first condition is executed and a signal feature of the target photovoltaic unit that is received after the first condition is executed.

[0077] It should be noted that in this embodiment, one high-voltage direct current string is used as an example for description. When the solar photovoltaic power generation system includes a plurality of high-voltage direct current strings, for each high-voltage direct current string, location information of a controller in each high-voltage direct current string may be obtained in sequence by using the foregoing method in this embodiment.

[0078] In this embodiment, the high-voltage direct current strings in the solar photovoltaic power generation system have been grouped, that is, the inverter has learned of grouping information of the high-voltage direct current strings. In an implementation, when the inverter does not learn of the grouping information of the high-voltage direct current strings, before S101, the grouping information of the high-voltage direct current strings further needs to be determined, and the method in this embodiment further include the following step.

[0079] S105: The inverter obtains signal feature information of each photovoltaic unit in the solar photovoltaic power generation system, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, and the signal feature is a signal feature obtained when any photovoltaic unit in the solar photovoltaic power generation system communicates with the inverter or one photovoltaic unit in the solar photovoltaic power generation system, or a signal feature obtained when the any photovoltaic unit broadcasts.

[0080] Specifically, in an implementation, when the signal feature of the photovoltaic unit is a signal feature obtained when another photovoltaic unit communicates with the inverter, and that the inverter obtains the signal feature information of each photovoltaic unit in the solar photovoltaic power generation system may specifically be:

S1051': The inverter communicates with each photovoltaic unit in the solar photovoltaic power generation system in sequence under the preset communication frequency band.

[0081] When the inverter communicates with one of the photovoltaic units, another photovoltaic unit stores a signal feature obtained when the photovoltaic unit communicates with the inverter.

[0082] S1052: The inverter sends a location positioning request to each photovoltaic unit in sequence.

[0083] S1053: The inverter receives the signal feature information sent by each photovoltaic unit after each photovoltaic unit receives the location positioning request.

[0084] In another implementation, that the inverter obtains signal feature information of each photovoltaic unit in the solar photovoltaic power generation system may specifically be:

[0085] S1051': The inverter communicates with each photovoltaic unit in the solar photovoltaic power generation system in sequence under the preset communication frequency band.

[0086] When the inverter communicates with one of the photovoltaic units, another photovoltaic unit stores a signal feature obtained when the photovoltaic unit communicates with the inverter.

[0087] S1052': The inverter broadcasts a location positioning request to each photovoltaic unit in the solar photovoltaic power generation system in sequence.

[0088] S1053': The inverter receives the signal feature information sent in sequence by each photovoltaic unit.

[0089] After S1051', each photovoltaic unit stores a signal feature obtained when another photovoltaic unit communicates with the inverter, and then the inverter broadcasts the location positioning request to each photovoltaic unit. When the location positioning request is broadcast, a preset interval may further be carried, that is, an interval at which each photovoltaic unit sends the signal feature information in sequence. For example, a first photovoltaic unit first sends signal feature information. When the first photovoltaic unit communicates with the inverter, a second photovoltaic unit may receive a signal feature of communication, and send the signal feature information to the inverter after the preset interval, and so on, until an N^{th} photovoltaic unit sends signal feature information to the inverter.

[0090] When the signal feature of the photovoltaic unit is a signal feature obtained when the photovoltaic unit communicates with a photovoltaic unit in the high-voltage direct current string, a photovoltaic unit is replaced with an inverter to perform S1051 or S1051', and then the inverter performs S1052 and S1053 or S1052' and S1053', to obtain the signal feature information of each photovoltaic unit in the high-voltage direct current string.

[0091] When the signal feature of the photovoltaic unit is a signal feature obtained when any photovoltaic unit broadcasts, and when a photovoltaic unit broadcasts, another photovoltaic stores the received signal feature obtained when the photovoltaic unit broadcasts, and then the inverter performs S1052 and S1053 or S1052' and S1053', to obtain the signal feature information of each photovoltaic unit in the high-voltage direct current string.

[0092] S106: The inverter determines, based on signal feature information of all photovoltaic units and according to a grouping rule, a quantity of high-voltage direct current strings included in the solar photovoltaic power generation system and a high-voltage direct current string to which each photovoltaic unit belongs, where the grouping rule is that

photovoltaic units adjacent to a photovoltaic unit in a same high-voltage direct current string may be determined based on the signal feature information of the photovoltaic units.

[0093] Specifically, S106 may specifically be as follows: First, a first photovoltaic unit is randomly selected, for example, a photovoltaic unit 1, and a photovoltaic unit adjacent to the first photovoltaic unit is determined based on signal feature information of all photovoltaic units, for example, the photovoltaic unit or photovoltaic units adjacent to the photovoltaic unit 1 is a photovoltaic unit 2 or are a photovoltaic unit 2 and a photovoltaic unit 3. Then, a photovoltaic unit that is adjacent to the photovoltaic unit adjacent to the first photovoltaic unit is determined based on signal feature information of the photovoltaic unit adjacent to the first photovoltaic unit and signal feature information of a photovoltaic unit other than the first photovoltaic unit and the photovoltaic unit adjacent to the first photovoltaic unit, that is, a photovoltaic unit adjacent to the photovoltaic unit 2 or to the photovoltaic unit 2 and the photovoltaic unit 3 is determined. Then, a photovoltaic unit that is adjacent to the photovoltaic unit adjacent to the photovoltaic unit 2 or to the photovoltaic unit 2 and the photovoltaic unit 3 is determined, and the determined photovoltaic units are included in a set corresponding to a high-voltage direct current string. Until there is no photovoltaic unit adjacent to a last photovoltaic unit or a photovoltaic unit adjacent to a last photovoltaic unit is a photovoltaic unit in the set, the determining process stops, and the determined photovoltaic units in the set are determined as photovoltaic units in a high-voltage direct current string. Then, the foregoing process is continued based on the signal feature information of the remaining photovoltaic units, to determine the photovoltaic units in a second high-voltage direct current string, until all high-voltage direct current strings included in the solar photovoltaic power generation system are determined.

[0094] By performing the foregoing steps, the inverter may determine the grouping information of the high-voltage direct current strings, and then perform S101 to S103, to obtain relative installation location information of each photovoltaic unit in each high-voltage direct current string, so as to obtain relative installation position information of each controller in each high-voltage direct current string.

[0095] According to the method for obtaining location information of a controller in this embodiment, the inverter obtains the signal feature information of each photovoltaic unit in the high-voltage direct current string, where the signal feature information of a photovoltaic unit includes the communication identifier of the photovoltaic unit, a communication identifier of another photovoltaic unit, and the signal feature corresponding to the another photovoltaic unit; determines the installation sequence of all photovoltaic units based on the signal feature information of all the photovoltaic units; and determines the relative installation location information of each photovoltaic unit based on the relative installation location information of the target photovoltaic unit in the high-voltage direct current string and the installation sequence of all the photovoltaic units. The relative installation location information of each photovoltaic unit is determined, and location information of a controller of each photovoltaic unit is also determined correspondingly. The relative installation location information of the target photovoltaic unit in the high-voltage direct current string may be manually obtained and then pre-stored in the inverter, or obtained by the inverter, so that the location information of the controller in the high-voltage direct current string in a photovoltaic system may be obtained full-automatically or semi-automatically. This saves labor and improves installation efficiency and operation and maintenance efficiency.

[0096] The technical solution of the method embodiment shown in FIG. 2 is described in detail below by using a specific embodiment.

[0097] FIG. 4 is a flowchart of an embodiment of a method for obtaining location information of a controller according to this application. As shown in FIG. 4, the method in this embodiment may include the following steps.

[0098] S201: An inverter obtains relative installation location information of a target photovoltaic unit in a high-voltage direct current string, where the target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string.

[0099] The target photovoltaic unit may be a first photovoltaic unit or a last photovoltaic unit in the high-voltage direct current string, or may be at least one photovoltaic unit adjacent to a first photovoltaic unit, or may be at least one photovoltaic unit adjacent to a last photovoltaic unit.

[0100] Specifically, three implementations are as follows:

Implementation 1: The inverter communicates with the target photovoltaic unit when disconnecting a direct current input switch of the inverter, and the inverter determines the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit; or
the inverter communicates with the target photovoltaic unit when disconnecting a direct current input switch of the inverter, and the inverter determines the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit when the direct current input switch of the inverter is not disconnected and a received signal feature of the target photovoltaic unit when the direct current input switch of the inverter is disconnected.

Implementation 2: The inverter communicates with the target photovoltaic unit when a positive electrode of the high-voltage direct current string is disconnected, and the inverter determines the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit; or

the inverter communicates with the target photovoltaic unit when a positive electrode of the high-voltage direct current string is disconnected, and the inverter determines the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit when the positive electrode of the high-voltage direct current string is not disconnected (that is, in a normal condition) and a received signal feature of the target photovoltaic unit when the positive electrode of the high-voltage direct current string is disconnected.

Implementation 3: The inverter communicates with the target photovoltaic unit when a negative electrode of the high-voltage direct current string is disconnected, and the inverter determines the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit; or

the inverter communicates with the target photovoltaic unit when a negative electrode of the high-voltage direct current string is disconnected, and the inverter determines the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit when the negative electrode of the high-voltage direct current string is not disconnected and a received signal feature of the target photovoltaic unit when the negative electrode of the high-voltage direct current string is disconnected.

[0101] S202: The inverter obtains signal feature information of each photovoltaic unit in the high-voltage direct current string, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature obtained when another photovoltaic unit communicates with the inverter.

[0102] Specifically, the signal feature information may be obtained by performing S1011 to S1013 or S1011' to S1013'. For a detailed process, refer to description of S1011 to S1013 or S1011' to S1013' in the embodiment shown in FIG. 2. Details are not described herein again.

[0103] S203: The inverter determines an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units.

[0104] Specifically, the inverter first determines a photovoltaic unit adjacent to each photovoltaic unit in sequence and based on the signal feature information of all the photovoltaic units, and performs sequencing based on the photovoltaic unit adjacent to each photovoltaic unit and a communication identifier of each photovoltaic unit, to obtain the installation sequence of all the photovoltaic units.

[0105] S204: The inverter determines relative installation location information of each photovoltaic unit based on the relative installation location information of the target photovoltaic unit in the high-voltage direct current string and the installation sequence of all the photovoltaic units, and obtains location information of a controller of each photovoltaic unit based on the relative installation location information of each photovoltaic unit.

[0106] FIG. 5 is a schematic structural diagram of an embodiment of an apparatus for obtaining location information of a controller according to this application. As shown in FIG. 5, the apparatus in this embodiment may include a first obtaining module 11, a first determining module 12, and a second determining module 13.

[0107] The first obtaining module 11 is configured to obtain signal feature information of each photovoltaic unit in a high-voltage direct current string, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter or one photovoltaic unit in the high-voltage direct current string, or a signal feature obtained when the any photovoltaic unit broadcasts, and the photovoltaic unit includes one controller and at least one photovoltaic module.

[0108] The first determining module 12 is configured to determine an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units.

[0109] The second determining module 13 is configured to determine relative installation location information of each photovoltaic unit based on relative installation location information of a target photovoltaic unit in the high-voltage direct current string and the installation sequence of all the photovoltaic units, where the target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string.

[0110] Further, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter, and the first obtaining module 11 is configured to:

communicate with each photovoltaic unit in the high-voltage direct current string in sequence;
send a location positioning request to each photovoltaic unit in the high-voltage direct current string in sequence; and
receive the signal feature information sent by each photovoltaic unit after each photovoltaic unit receives the location positioning request.

[0111] Further, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter, and the first obtaining module 11 is configured to:

communicate with each photovoltaic unit in the high-voltage direct current string in sequence;
broadcast a location positioning request to each photovoltaic unit in the high-voltage direct current string; and

receive the signal feature information sent in sequence by each photovoltaic unit.

[0112] Further, the first determining module 12 is configured to:

determine a photovoltaic unit adjacent to each photovoltaic unit in sequence and based on the signal feature information of all the photovoltaic units; and
perform sequencing based on the photovoltaic unit adjacent to each photovoltaic unit and a communication identifier of each photovoltaic unit, to obtain the installation sequence of all the photovoltaic units.

[0113] Optionally, the first obtaining module 11 is further configured to
obtain the relative installation location information of the target photovoltaic unit in the high-voltage direct current string.

[0114] Further, the first obtaining module 11 is configured to:

communicate with the target photovoltaic unit under a first condition, where the first condition is any one of disconnecting a direct current input switch of the inverter, disconnecting a positive electrode of the high-voltage direct current string, and disconnecting a negative electrode of the high-voltage direct current string; and
determine the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit; or
determine the relative installation location information of the target photovoltaic unit based on a signal feature of the target photovoltaic unit that is received before the first condition is executed and a signal feature of the target photovoltaic unit that is received after the first condition is executed.

[0115] Optionally, the relative installation location information of the target photovoltaic unit in the high-voltage direct current string is pre-stored in the inverter.

[0116] The apparatus in this embodiment may be configured to execute the technical solutions of the method embodiment shown in FIG. 2. Implementation principles and technical effects are similar, and details are not described herein again.

[0117] FIG. 6 is a schematic structural diagram of an embodiment of an apparatus for obtaining location information of a controller according to this application. As shown in FIG. 6, the apparatus in this embodiment may further include a second obtaining module 14 and a third determining module 15 based on the structure of the apparatus shown in FIG. 5.

[0118] The second obtaining module 14 is configured to obtain signal feature information of each photovoltaic unit in a solar photovoltaic power generation system, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, and the signal feature is a signal feature obtained when any photovoltaic unit in the solar photovoltaic power generation system communicates with the inverter or one photovoltaic unit in the solar photovoltaic power generation system, or a signal feature obtained when the any photovoltaic unit broadcasts.

[0119] The third determining module 15 is configured to determine, based on signal feature information of all photovoltaic units and according to a grouping rule, a quantity of high-voltage direct current strings included in the solar photovoltaic power generation system and a high-voltage direct current string to which each photovoltaic unit belongs, where the grouping rule is that photovoltaic units adjacent to a photovoltaic unit in a same high-voltage direct current string may be determined based on the signal feature information of the photovoltaic units.

[0120] The apparatus in this embodiment may be configured to execute the technical solutions of the method embodiment shown in FIG. 2. Implementation principles and technical effects are similar, and details are not described herein again.

[0121] In this application, the apparatus for obtaining location information of a controller may be divided into functional modules based on the foregoing method examples. For example, functional modules corresponding to functions may be obtained through division, or two or more functions may be integrated into one processing module. The integrated module may be implemented in a form of hardware, or may be implemented in a form of a software functional module. It should be noted that, in the embodiments of this application, division into the modules is an example, and is merely logical function division. During actual implementation, another division manner may be used.

[0122] FIG. 7 is a schematic structural diagram of a device according to this application. As shown in FIG. 7, the device 200 includes a memory 201 and a processor 202.

[0123] The memory 201 is configured to store a computer program.

[0124] The processor 202 is configured to execute the computer program stored in the memory, to implement the printing method in the foregoing embodiments. For details, refer to related description in the foregoing method embodiments.

[0125] Optionally, the memory 201 may be independent, or may be integrated with the processor 202.

[0126] When the memory 201 is a device independent of the processor 202, the device 200 may further include:

a bus 203, configured to connect the memory 201 and the processor 202.

[0127] Optionally, this embodiment further includes a communications interface 204. The communications interface 204 may be connected to the processor 202 by using the bus 203. The processor 202 may control the communications interface 203 to implement the foregoing receiving and sending functions of the device 200.

[0128] The device may be configured to perform steps and/or procedures corresponding to the inverter in the foregoing method embodiments.

[0129] This application further provides a readable storage medium. The readable storage medium stores executable instructions. When at least one processor of a device executes the executable instructions, the device performs the method for obtaining location information of a controller in the foregoing method embodiments.

[0130] This application further provides a program product. The program product includes executable instructions, and the executable instructions are stored in a readable storage medium. At least one processor of a device may read the executable instructions from the readable storage medium, and the at least one processor executes the executable instructions, so that the device performs the method for obtaining location information of a controller in the foregoing method embodiments.

[0131] This application further provides a chip. The chip is connected to a memory, or a memory is integrated into the chip. When a software program stored in the memory is executed, the method for obtaining location information of a controller in the foregoing method embodiments is implemented.

[0132] A person of ordinary skill in the art may understand that all or some of the foregoing embodiments may be implemented by using software, hardware, firmware, or any combination thereof. When software is used to implement the embodiments, all or some of the embodiments may be implemented in a form of a computer program product. The computer program product includes one or more computer instructions. When the computer program instructions are loaded and executed on a computer, a procedure or functions according to the embodiments of this application are all or partially generated. The computer may be a general-purpose computer, a dedicated computer, a computer network, or another programmable apparatus. The computer instructions may be stored in a computer-readable storage medium or may be transmitted from one computer-readable storage medium to another computer-readable storage medium. For example, the computer instructions may be transmitted from one website, computer, server, or data center to another website, computer, server, or data center in a wired (for example, a coaxial cable, an optical fiber, or a digital subscriber line (DSL)) or wireless (for example, infrared, radio, or microwave) manner. The computer-readable storage medium may be any usable medium accessible by the computer, or a data storage device, such as a server or a data center, integrating one or more usable media. The usable medium may be a magnetic medium (for example, a floppy disk, a hard disk, or a magnetic tape), an optical medium (for example, a DVD), a semiconductor medium (for example, a solid-state disk (Solid-State Disk, SSD)), or the like.

Claims

1. A method for obtaining location information of a controller (2), comprising:

obtaining, by an inverter (3), signal feature information of each photovoltaic unit in a high-voltage direct current string (4), wherein the signal feature information of a photovoltaic unit comprises a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string (4) communicates with the inverter (3) or one photovoltaic unit in the high-voltage direct current string (4), or a signal feature obtained when the any photovoltaic unit broadcasts, and the photovoltaic unit comprises one controller (2) and at least one photovoltaic module (1);

characterized in that the method further comprises:

determining, by the inverter (3), an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units; and

determining, by the inverter (3), relative installation location information of each photovoltaic unit based on relative installation location information of a target photovoltaic unit in the high-voltage direct current string (4) and the installation sequence of all the photovoltaic units, wherein the target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string (4),

wherein the determining, by the inverter (3), an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units comprises:

determining, by the inverter (3), a photovoltaic unit adjacent to each photovoltaic unit in sequence and based on the signal feature information of all the photovoltaic units; and

performing sequencing, by the inverter (3), based on the photovoltaic unit adjacent to each photovoltaic unit and a communication identifier of each photovoltaic unit, to obtain the installation sequence of all the photovoltaic units,
wherein the photovoltaic units adjacent to the photovoltaic unit are two photovoltaic units with the strongest signal features.

2. The method according to claim 1, wherein the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string (4) communicates with the inverter (3), and the obtaining, by an inverter (3), signal feature information of each photovoltaic unit in a high-voltage direct current string (4) comprises:

communicating, by the inverter (3), with each photovoltaic unit in the high-voltage direct current string (4) in sequence;
sending, by the inverter (3), a location positioning request to each photovoltaic unit in the high-voltage direct current string (4) in sequence; and
receiving, by the inverter (3), the signal feature information sent by each photovoltaic unit after each photovoltaic unit receives the location positioning request.

3. The method according to claim 1, wherein the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string (4) communicates with the inverter (3), and the obtaining, by an inverter (3), signal feature information of each photovoltaic unit in a high-voltage direct current string (4) comprises:

communicating, by the inverter (3), with each photovoltaic unit in the high-voltage direct current string (4) in sequence;
broadcasting, by the inverter (3), a location positioning request to each photovoltaic unit in the high-voltage direct current string (4); and
receiving, by the inverter (3), the signal feature information sent in sequence by each photovoltaic unit.

4. The method according to any one of claims 1 to 3, wherein the method further comprises:
obtaining, by the inverter (3), the relative installation location information of the target photovoltaic unit in the high-voltage direct current string (4).

5. The method according to claim 4, the obtaining, by the inverter (3), the relative installation location information of the target photovoltaic unit in the high-voltage direct current string (4) comprises:

communicating, by the inverter (3), with the target photovoltaic unit under a first condition, wherein the first condition is any one of disconnecting a direct current input switch of the inverter (3), disconnecting a positive electrode of the high-voltage direct current string (4), and disconnecting a negative electrode of the high-voltage direct current string (4); and
determining, by the inverter (3), the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit; or
determining, by the inverter (3), the relative installation location information of the target photovoltaic unit based on a signal feature of the target photovoltaic unit that is received before the first condition is executed and a signal feature of the target photovoltaic unit that is received after the first condition is executed.

6. The method according to any one of claims 1 to 3, wherein the relative installation location information of the target photovoltaic unit in the high-voltage direct current string (4) is pre-stored in the inverter (3).

7. The method according to claim 1, wherein the method further comprises:

obtaining, by the inverter (3), signal feature information of each photovoltaic unit in a solar photovoltaic power generation system, wherein the signal feature information of a photovoltaic unit comprises a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, and the signal feature is a signal feature obtained when any photovoltaic unit in the solar photovoltaic power generation system communicates with the inverter (3) or one photovoltaic unit in the solar photovoltaic power generation system, or a signal feature obtained when the any photovoltaic unit broadcasts; and
determining, by the inverter (3) based on signal feature information of all photovoltaic units and according to a grouping rule, a quantity of high-voltage direct current strings (4) comprised in the solar photovoltaic power generation system and a high-voltage direct current string (4) to which each photovoltaic unit belongs, wherein

the grouping rule is that photovoltaic units adjacent to a photovoltaic unit in a same high-voltage direct current string (4) may be determined based on the signal feature information of the photovoltaic units.

8. An apparatus for obtaining location information of a controller (2), comprising:

a first obtaining module (11), configured to obtain signal feature information of each photovoltaic unit in a high-voltage direct current string (4), wherein the signal feature information of a photovoltaic unit comprises a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string (4) communicates with an inverter (3) or one photovoltaic unit in the high-voltage direct current string (4), or a signal feature obtained when the any photovoltaic unit broadcasts, and the photovoltaic unit comprises one controller (2) and at least one photovoltaic module (1);
characterized in that the apparatus further comprises:

a first determining module (12), configured to determine an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units; and
a second determining module (13), configured to determine relative installation location information of each photovoltaic unit based on relative installation location information of a target photovoltaic unit in the high-voltage direct current string (4) and the installation sequence of all the photovoltaic units, wherein the target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string (4),
wherein the first determining module (12) is further configured to:

determine a photovoltaic unit adjacent to each photovoltaic unit in sequence and based on the signal feature information of all the photovoltaic units; and
perform sequencing based on the photovoltaic unit adjacent to each photovoltaic unit and a communication identifier of each photovoltaic unit, to obtain the installation sequence of all the photovoltaic units,
wherein the photovoltaic units adjacent to the photovoltaic unit are two photovoltaic units with the strongest signal features.

9. The apparatus according to claim 8, wherein the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string (4) communicates with the inverter (3), and the first obtaining module (11) is configured to:

communicate with each photovoltaic unit in the high-voltage direct current string (4) in sequence;
send a location positioning request to each photovoltaic unit in the high-voltage direct current string (4) in sequence; and
receive the signal feature information sent by each photovoltaic unit after each photovoltaic unit receives the location positioning request.

10. The apparatus according to claim 8, wherein the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string (4) communicates with the inverter (3), and the first obtaining module (11) is configured to:

communicate with each photovoltaic unit in the high-voltage direct current string (4) in sequence;
broadcast a location positioning request to each photovoltaic unit in the high-voltage direct current string (4); and
receive the signal feature information sent in sequence by each photovoltaic unit.

11. The apparatus according to any one of claims 8 to 10, wherein the first obtaining module (11) is further configured to: obtain the relative installation location information of the target photovoltaic unit in the high-voltage direct current string (4).

12. The apparatus according to claim 11, wherein the first obtaining module (11) is configured to:

communicate with the target photovoltaic unit under a first condition, wherein the first condition is any one of disconnecting a direct current input switch of the inverter (3), disconnecting a positive electrode of the high-voltage direct current string (4), and disconnecting a negative electrode of the high-voltage direct current string (4); and

determine the relative installation location information of the target photovoltaic unit based on a received signal feature of the target photovoltaic unit; or
determine the relative installation location information of the target photovoltaic unit based on a signal feature of the target photovoltaic unit that is received before the first condition is executed and a signal feature of the target photovoltaic unit that is received after the first condition is executed.

13. The apparatus according to any one of claims 8 to 10, wherein the relative installation location information of the target photovoltaic unit in the high-voltage direct current string (4) is pre-stored in the inverter (3).

14. The apparatus according to claim 8, wherein the apparatus further comprises:

a second obtaining module (14), configured to obtain signal feature information of each photovoltaic unit in a solar photovoltaic power generation system, wherein the signal feature information of a photovoltaic unit comprises a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, and the signal feature is a signal feature obtained when any photovoltaic unit in the solar photovoltaic power generation system communicates with the inverter (3) or one photovoltaic unit in the solar photovoltaic power generation system, or a signal feature obtained when the any photovoltaic unit broadcasts; and
a third determining module (15), configured to determine, based on signal feature information of all photovoltaic units and according to a grouping rule, a quantity of high-voltage direct current strings (4) comprised in the solar photovoltaic power generation system and a high-voltage direct current string (4) to which each photovoltaic unit belongs, wherein the grouping rule is that photovoltaic units adjacent to a photovoltaic unit in a same high-voltage direct current string (4) may be determined based on the signal feature information of the photovoltaic units.

15. A device (200), comprising:

a processor (202); and
a memory (201), configured to store executable instructions of the processor (202), wherein
the processor (202) is configured to perform, by executing the executable instructions, the method for obtaining location information of a controller (2) according to any one of claims 1 to 7.

16. A readable storage medium, wherein the readable storage medium stores executable instructions, and when at least one processor (202) of a device (200) executes the executable instructions, the device (200) performs the method for obtaining location information of a controller (2) according to any one of claims 1 to 7.

Patentansprüche

1. Verfahren zum Erhalten von Lageinformationen einer Steuerung (2), umfassend:

Erhalten, durch einen Inverter (3), von Signalmerkmalsinformationen jeder Photovoltaikeinheit in einem Hochspannungsgleichstromstrang (4), wobei die Signalmerkmalsinformationen einer Photovoltaikeinheit eine Kommunikationskennung der Photovoltaikeinheit und ein Signalmerkmal einer anderen Photovoltaikeinheit umfassen, wobei das Signalmerkmal ein Signalmerkmal, das erhalten wird, wenn eine beliebige Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) mit dem Inverter (3) oder einer Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) kommuniziert, oder ein Signalmerkmal, das erhalten wird, wenn die beliebige Photovoltaikeinheit rundsendet, ist, und wobei die Photovoltaikeinheit eine Steuerung (2) und mindestens ein Photovoltaikmodul (1) umfasst;
dadurch gekennzeichnet, dass das Verfahren ferner Folgendes umfasst:

Bestimmen, durch den Inverter (3), einer Installationsreihenfolge aller Photovoltaikeinheiten basierend auf Signalmerkmalsinformationen aller der Photovoltaikeinheiten; und
Bestimmen, durch den Inverter (3), relativer Installationslageinformationen jeder Photovoltaikeinheit basierend auf relativen Installationslageinformationen einer Ziel-Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) und der Installationsreihenfolge aller der Photovoltaikeinheiten, wobei die Ziel-Photovoltaikeinheit mindestens eine Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) ist,
wobei das Bestimmen, durch den Inverter (3), einer Installationsreihenfolge aller Photovoltaikeinheiten basierend auf Signalmerkmalsinformationen aller der Photovoltaikeinheiten Folgendes umfasst:

Bestimmen, durch den Inverter (3), einer an jede Photovoltaikeinheit angrenzenden Photovoltaikeinheit in Reihenfolge und basierend auf den Signalmerkmalsinformationen aller der Photovoltaikeinheiten; und

Durchführen einer Reihenfolgebestimmung, durch den Inverter (3), basierend auf der an jede Photovoltaikeinheit angrenzenden Photovoltaikeinheit und einer Kommunikationskennung jeder Photovoltaikeinheit, um die Installationsreihenfolge aller der Photovoltaikeinheiten zu erhalten,

wobei die an die Photovoltaikeinheit angrenzenden Photovoltaikeinheiten zwei Photovoltaikeinheiten mit den stärksten Signalmerkmalen sind.

2. Verfahren nach Anspruch 1, wobei das Signalmerkmal ein Signalmerkmal ist, das erhalten wird, wenn eine beliebige Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) mit dem Inverter (3) kommuniziert, und das Erhalten, durch einen Inverter (3), von Signalmerkmalsinformationen jeder Photovoltaikeinheit in einem Hochspannungsgleichstromstrang (4) Folgendes umfasst:

Kommunizieren, durch den Inverter (3), mit jeder Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) in Reihenfolge;

Senden, durch den Inverter (3), einer Lagepositionsbestimmungsanfrage an jede Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) in Reihenfolge; und Empfangen, durch den Inverter (3), der Signalmerkmalsinformationen, die durch jede Photovoltaikeinheit gesendet werden, nachdem jede Photovoltaikeinheit die Lagepositionsbestimmungsanfrage empfängt.

3. Verfahren nach Anspruch 1, wobei das Signalmerkmal ein Signalmerkmal ist, das erhalten wird, wenn eine beliebige Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) mit dem Inverter (3) kommuniziert, und das Erhalten, durch einen Inverter (3), von Signalmerkmalsinformationen jeder Photovoltaikeinheit in einem Hochspannungsgleichstromstrang (4) Folgendes umfasst:

Kommunizieren, durch den Inverter (3), mit jeder Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) in Reihenfolge;

Rundsenden, durch den Inverter (3), einer Lagepositionsbestimmungsanfrage an jede Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4); und

Empfangen, durch den Inverter (3), der durch jede Photovoltaikeinheit in Reihenfolge gesendeten Signalmerkmalsinformationen.

4. Verfahren nach einem der Ansprüche 1 bis 3, wobei das Verfahren ferner Folgendes umfasst:
Erhalten, durch den Inverter (3), der relativen Installationslageinformationen der Ziel-Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4).

5. Verfahren nach Anspruch 4, wobei das Erhalten, durch den Inverter (3), der relativen Installationslageinformationen der Ziel-Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) Folgendes umfasst:

Kommunizieren, durch den Inverter (3), mit der Ziel-Photovoltaikeinheit unter einer ersten Bedingung, wobei die erste Bedingung ein beliebiges von Trennen eines Gleichstrom-Eingangsschalters des Inverters (3), Trennen einer positiven Elektrode des Hochspannungsgleichstromstrangs (4) und Trennen einer negativen Elektrode des Hochspannungsgleichstromstrangs (4) ist, und

Bestimmen, durch den Inverter (3), der relativen Installationslageinformationen der Ziel-Photovoltaikeinheit basierend auf einem empfangenen Signalmerkmal der Ziel-Photovoltaikeinheit, oder

Bestimmen, durch den Inverter (3), der relativen Installationslageinformationen der Ziel-Photovoltaikeinheit basierend auf einem Signalmerkmal der Ziel-Photovoltaikeinheit, das empfangen wird, bevor die erste Bedingung ausgeführt wird, und einem Signalmerkmal der Ziel-Photovoltaikeinheit, das empfangen wird, nachdem die erste Bedingung ausgeführt wird.

6. Verfahren nach einem der Ansprüche 1 bis 3, wobei die relativen Installationslageinformationen der Ziel-Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) in dem Inverter (3) vorgespeichert werden.

7. Verfahren nach Anspruch 1, wobei das Verfahren ferner Folgendes umfasst:

Erhalten, durch den Inverter (3), von Signalmerkmalsinformationen jeder Photovoltaikeinheit in einem Photovoltaik-Solarstromerzeugungssystem, wobei die Signalmerkmalsinformationen einer Photovoltaikeinheit eine

Kommunikationskennung der Photovoltaikeinheit und ein Signalmerkmal einer anderen Photovoltaikeinheit umfassen, und wobei das Signalmerkmal ein Signalmerkmal, das erhalten wird, wenn eine beliebige Photovoltaikeinheit in dem Photovoltaik-Solarstromerzeugungssystem mit dem Inverter (3) oder einer Photovoltaikeinheit in dem Photovoltaik-Solarstromerzeugungssystem kommuniziert,
oder ein Signalmerkmal, das erhalten wird, wenn die beliebige Photovoltaikeinheit rundsendet, ist; und
Bestimmen, durch den Inverter (3) basierend auf Signalmerkmalsinformationen aller Photovoltaikeinheiten und gemäß einer Gruppierungsregel, einer Anzahl von Hochspannungsgleichstromsträngen (4), die in dem Photovoltaik-Solarstromerzeugungssystem enthalten sind, und eines Hochspannungsgleichstromstrangs (4), zu dem jede Photovoltaikeinheit gehört, wobei die Gruppierungsregel ist, dass an eine Photovoltaikeinheit in einem gleichen Hochspannungsgleichstromstrang (4) angrenzende Photovoltaikeinheiten basierend auf den Signalmerkmalsinformationen der Photovoltaikeinheiten bestimmt werden können.

8. Einrichtung zum Erhalten von Lageinformationen einer Steuerung (2), umfassend:

ein erstes Erhaltungsmodul (11), das dazu konfiguriert ist, Signalmerkmalsinformationen jeder Photovoltaikeinheit in einem Hochspannungsgleichstromstrang (4) zu erhalten, wobei die Signalmerkmalsinformationen einer Photovoltaikeinheit eine Kommunikationskennung der Photovoltaikeinheit und ein Signalmerkmal einer anderen Photovoltaikeinheit umfassen, wobei das Signalmerkmal ein Signalmerkmal, das erhalten wird, wenn eine beliebige Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) mit einem Inverter (3) oder einer Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) kommuniziert, oder ein Signalmerkmal, das erhalten wird, wenn die beliebige Photovoltaikeinheit rundsendet, ist, und wobei die Photovoltaikeinheit eine Steuerung (2) und mindestens ein Photovoltaikmodul (1) umfasst;
dadurch gekennzeichnet, dass die Einrichtung ferner Folgendes umfasst:

ein erstes Bestimmungsmodul (12), das dazu konfiguriert ist, eine Installationsreihenfolge aller Photovoltaikeinheiten basierend auf Signalmerkmalsinformationen aller der Photovoltaikeinheiten zu bestimmen, und
ein zweites Bestimmungsmodul (13), das dazu konfiguriert ist, relative Installationslageinformationen jeder Photovoltaikeinheit basierend auf relativen Installationslageinformationen einer Ziel-Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) und der Installationsreihenfolge aller der Photovoltaikeinheiten zu bestimmen, wobei die Ziel-Photovoltaikeinheit mindestens eine Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) ist,
wobei das erste Bestimmungsmodul (12) ferner zu Folgendem konfiguriert ist:

Bestimmen einer an jede Photovoltaikeinheit angrenzenden Photovoltaikeinheit in Reihenfolge und basierend auf den Signalmerkmalsinformationen aller der Photovoltaikeinheiten; und
Durchführen einer Reihenfolgebestimmung basierend auf der an jede Photovoltaikeinheit angrenzenden Photovoltaikeinheit und einer Kommunikationskennung jeder Photovoltaikeinheit, um die Installationsreihenfolge aller der Photovoltaikeinheiten zu erhalten,
wobei die an die Photovoltaikeinheit angrenzenden Photovoltaikeinheiten zwei Photovoltaikeinheiten mit den stärksten Signalmerkmalen sind.

9. Einrichtung nach Anspruch 8, wobei das Signalmerkmal ein Signalmerkmal ist, das erhalten wird, wenn eine beliebige Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) mit dem Inverter (3) kommuniziert, und das erste Erhaltungsmodul (11) zu Folgendem konfiguriert ist:

Kommunizieren mit jeder Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) in Reihenfolge;
Senden einer Lagepositionsbestimmungsanfrage an jede Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) in Reihenfolge; und
Empfangen der Signalmerkmalsinformationen, die durch jede Photovoltaikeinheit gesendet werden, nachdem jede Photovoltaikeinheit die Lagepositionsbestimmungsanfrage empfängt.

10. Einrichtung nach Anspruch 8, wobei das Signalmerkmal ein Signalmerkmal ist, das erhalten wird, wenn eine beliebige Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) mit dem Inverter (3) kommuniziert, und das erste Erhaltungsmodul (11) zu Folgendem konfiguriert ist:

Kommunizieren mit jeder Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) in Reihenfolge;
Rundsenden einer Lagepositionsbestimmungsanfrage an jede Photovoltaikeinheit in dem Hochspannungs-

gleichstromstrang (4); und
Empfangen der durch jede Photovoltaikeinheit in Reihenfolge gesendeten Signalmerkmalsinformationen.

11. Einrichtung nach einem der Ansprüche 8 bis 10, wobei das erste Erhaltungsmodul (11) ferner zu Folgendem konfiguriert ist:
Erhalten der relativen Installationslageinformationen der Ziel-Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4).

12. Einrichtung nach Anspruch 11, wobei das erste Erhaltungsmodul (11) ferner zu Folgendem konfiguriert ist:

Kommunizieren mit der Ziel-Photovoltaikeinheit unter einer ersten Bedingung, wobei die erste Bedingung ein beliebiges von Trennen eines Gleichstrom-Eingangsschalters des Inverters (3), Trennen einer positiven Elektrode des Hochspannungsgleichstromstrangs (4) und Trennen einer negativen Elektrode des Hochspannungsgleichstromstrangs (4) ist, und
Bestimmen der relativen Installationslageinformationen der Ziel-Photovoltaikeinheit basierend auf einem empfangenen Signalmerkmal der Ziel-Photovoltaikeinheit, oder Bestimmen der relativen Installationslageinformationen der Ziel-Photovoltaikeinheit basierend auf einem Signalmerkmal der Ziel-Photovoltaikeinheit, das empfangen wird, bevor die erste Bedingung ausgeführt wird, und einem Signalmerkmal der Ziel-Photovoltaikeinheit, das empfangen wird, nachdem die erste Bedingung ausgeführt wird.

13. Einrichtung nach einem der Ansprüche 8 bis 10, wobei die relativen Installationslageinformationen der Ziel-Photovoltaikeinheit in dem Hochspannungsgleichstromstrang (4) in dem Inverter (3) vorgespeichert sind.

14. Einrichtung nach Anspruch 8, wobei die Einrichtung ferner Folgendes umfasst:

ein zweites Erhaltungsmodul (14), das dazu konfiguriert ist, Signalmerkmalsinformationen jeder Photovoltaikeinheit in einem Photovoltaik-Solarstromerzeugungssystem zu erhalten, wobei die Signalmerkmalsinformationen einer Photovoltaikeinheit eine Kommunikationskennung der Photovoltaikeinheit und ein Signalmerkmal einer anderen Photovoltaikeinheit umfassen, und wobei das Signalmerkmal ein Signalmerkmal, das erhalten wird, wenn eine beliebige Photovoltaikeinheit in dem Photovoltaik-Solarstromerzeugungssystem mit dem Inverter (3) oder einer Photovoltaikeinheit in dem Photovoltaik-Solarstromerzeugungssystem kommuniziert, oder ein Signalmerkmal, das erhalten wird, wenn die beliebige Photovoltaikeinheit rundsendet, ist; und
ein drittes Bestimmungsmodul (15), das dazu konfiguriert ist, basierend auf Signalmerkmalsinformationen aller Photovoltaikeinheiten und gemäß einer Gruppierungsregel eine Anzahl von Hochspannungsgleichstromsträngen (4), die in dem Photovoltaik-Solarstromerzeugungssystem enthalten sind, und einen Hochspannungsgleichstromstrang (4), zu dem jede Photovoltaikeinheit gehört, zu bestimmen, wobei die Gruppierungsregel ist, dass an eine Photovoltaikeinheit in einem gleichen Hochspannungsgleichstromstrang (4) angrenzende Photovoltaikeinheiten basierend auf den Signalmerkmalsinformationen der Photovoltaikeinheiten bestimmt werden können.

15. Vorrichtung (200), umfassend:

einen Prozessor (202); und
einen Speicher (201), der dazu konfiguriert ist, ausführbare Anweisungen des Prozessors (202) zu speichern, wobei
der Prozessor (202) dazu konfiguriert ist, durch Ausführen der ausführbaren Anweisungen das Verfahren zum Erhalten von Lageinformationen einer Steuerung (2) nach einem der Ansprüche 1 bis 7 durchzuführen.

16. Lesbares Speichermedium, wobei das lesbare Speichermedium ausführbare Anweisungen speichert, und, wenn mindestens ein Prozessor (202) einer Vorrichtung (200) die ausführbaren Anweisungen ausführt, die Vorrichtung (200) das Verfahren zum Erhalten von Lageinformationen einer Steuerung (2) nach einem der Ansprüche 1 bis 7 durchführt.

Revendications

1. Procédé d'obtention d'informations de position d'un dispositif de commande (2), comprenant :

l'obtention, par un onduleur (3), d'informations de caractéristique de signal de chaque unité photovoltaïque dans une branche de courant continu à haute tension (4), dans lequel les informations de caractéristique de signal d'une unité photovoltaïque comprennent un identifiant de communication de l'unité photovoltaïque et une caractéristique de signal d'une autre unité photovoltaïque, la caractéristique de signal est une caractéristique de signal obtenue lorsqu'une quelconque unité photovoltaïque dans la branche de courant continu à haute tension (4) communique avec l'onduleur (3) ou une unité photovoltaïque dans la branche de courant continu à haute tension (4), ou une caractéristique de signal obtenue lorsque ladite quelconque unité photovoltaïque diffuse, et l'unité photovoltaïque comprend un dispositif de commande (2) et au moins un module photovoltaïque (1) ;

caractérisé en ce que le procédé comprend en outre :

la détermination, par l'onduleur (3), d'une séquence d'installation de toutes les unités photovoltaïques sur la base d'informations de caractéristique de signal de toutes les unités photovoltaïques ; et
la détermination, par l'onduleur (3), d'informations de position d'installation relative de chaque unité photovoltaïque sur la base d'informations de position d'installation relative d'une unité photovoltaïque cible dans la branche de courant continu à haute tension (4) et de la séquence d'installation de toutes les unités photovoltaïques, dans lequel l'unité photovoltaïque cible est au moins une unité photovoltaïque dans la branche de courant continu à haute tension (4),
dans lequel la détermination, par l'onduleur (3), d'une séquence d'installation de toutes les unités photovoltaïques sur la base d'informations de caractéristique de signal de toutes les unités photovoltaïques comprend :

la détermination, par l'onduleur (3), d'une unité photovoltaïque adjacente à chaque unité photovoltaïque en séquence et sur la base des informations de caractéristique de signal de toutes les unités photovoltaïques ; et
l'exécution du séquençage, par l'onduleur (3), sur la base de l'unité photovoltaïque adjacente à chaque unité photovoltaïque et d'un identifiant de communication de chaque unité photovoltaïque, pour obtenir la séquence d'installation de toutes les unités photovoltaïques,
dans lequel les unités photovoltaïques adjacentes à l'unité photovoltaïque sont deux unités photovoltaïques ayant les plus fortes caractéristiques de signal.

2. Procédé selon la revendication 1, dans lequel la caractéristique de signal est une caractéristique de signal obtenue lorsqu'une quelconque unité photovoltaïque dans la branche de courant continu à haute tension (4) communique avec l'onduleur (3), et l'obtention, par un onduleur (3), d'informations de caractéristique de signal de chaque unité photovoltaïque dans une branche de courant continu à haute tension (4) comprend :

la communication, par l'onduleur (3), avec chaque unité photovoltaïque dans la branche de courant continu à haute tension (4) en séquence ;
l'envoi, par l'onduleur (3), d'une demande de positionnement à chaque unité photovoltaïque dans la branche de courant continu à haute tension (4) en séquence ; et
la réception, par l'onduleur (3), des informations de caractéristique de signal envoyées par chaque unité photovoltaïque après que chaque unité photovoltaïque reçoit la demande de positionnement.

3. Procédé selon la revendication 1, dans lequel la caractéristique de signal est une caractéristique de signal obtenue lorsqu'une quelconque unité photovoltaïque dans la branche de courant continu à haute tension (4) communique avec l'onduleur (3), et l'obtention, par un onduleur (3), d'informations de caractéristique de signal de chaque unité photovoltaïque dans une branche de courant continu à haute tension (4) comprend :

la communication, par l'onduleur (3), avec chaque unité photovoltaïque dans la branche de courant continu à haute tension (4) en séquence ;
la diffusion, par l'onduleur (3), d'une demande de positionnement à chaque unité photovoltaïque dans la branche de courant continu à haute tension (4) ; et
la réception, par l'onduleur (3), des informations de caractéristique de signal envoyées en séquence par chaque unité photovoltaïque.

4. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel le procédé comprend en outre :
l'obtention, par l'onduleur (3), des informations de position d'installation relative de l'unité photovoltaïque cible dans la branche de courant continu à haute tension (4).

5. Procédé selon la revendication 4, dans lequel l'obtention, par l'onduleur (3), des informations de position d'installation relative de l'unité photovoltaïque cible dans la branche de courant continu à haute tension (4) comprend :

la communication, par l'onduleur (3), avec l'unité photovoltaïque cible sous une première condition, dans lequel la première condition est l'une quelconque de la déconnexion d'un interrupteur d'entrée de courant continu de l'onduleur (3), la déconnexion d'une électrode positive de la branche de courant continu à haute tension (4), et la déconnexion d'une électrode négative de la branche de courant continu à haute tension (4) ; et
la détermination, par l'onduleur (3), des informations de position d'installation relative de l'unité photovoltaïque cible sur la base d'une caractéristique de signal reçue de l'unité photovoltaïque cible ; ou
la détermination, par l'onduleur (3), des informations de position d'installation relative de l'unité photovoltaïque cible sur la base d'une caractéristique de signal de l'unité photovoltaïque cible qui est reçue avant l'exécution de la première condition et d'une caractéristique de signal de l'unité photovoltaïque cible qui est reçue après l'exécution de la première condition.

6. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel les informations de position d'installation relative de l'unité photovoltaïque cible dans la branche de courant continu à haute tension (4) sont préstockées dans l'onduleur (3).

7. Procédé selon la revendication 1, dans lequel le procédé comprend en outre :

l'obtention, par l'onduleur (3), d'informations de caractéristique de signal de chaque unité photovoltaïque dans un système de production d'énergie photovoltaïque solaire, dans lequel les informations de caractéristique de signal d'une unité photovoltaïque comprennent un identifiant de communication de l'unité photovoltaïque et une caractéristique de signal d'une autre unité photovoltaïque, et la caractéristique de signal est une caractéristique de signal obtenue lorsqu'une quelconque unité photovoltaïque dans le système de production d'énergie photovoltaïque solaire communique avec l'onduleur (3) ou une unité photovoltaïque dans le système de production d'énergie photovoltaïque solaire, ou une caractéristique de signal obtenue lorsque ladite quelconque unité photovoltaïque diffuse ; et
la détermination, par l'onduleur (3) sur la base d'informations de caractéristique de signal de toutes les unités photovoltaïques et en fonction d'une règle de groupage, d'une quantité de branches de courant continu à haute tension (4) comprises dans le système de production d'énergie photovoltaïque solaire et d'une branche de courant continu à haute tension (4) à laquelle appartient chaque unité photovoltaïque, dans lequel la règle de groupage consiste en ce que des unités photovoltaïques adjacentes à une unité photovoltaïque dans une même branche de courant continu à haute tension (4) peuvent être déterminées sur la base des informations de caractéristique de signal des unités photovoltaïques.

8. Appareil destiné à obtenir des informations de position d'un dispositif de commande (2), comprenant :

un premier module d'obtention (11), configuré pour obtenir des informations de caractéristique de signal de chaque unité photovoltaïque dans une branche de courant continu à haute tension (4), dans lequel les informations de caractéristique de signal d'une unité photovoltaïque comprennent un identifiant de communication de l'unité photovoltaïque et une caractéristique de signal d'une autre unité photovoltaïque, la caractéristique de signal est une caractéristique de signal obtenue lorsqu'une quelconque unité photovoltaïque dans la branche de courant continu à haute tension (4) communique avec un onduleur (3) ou une unité photovoltaïque dans la branche de courant continu à haute tension (4), ou une caractéristique de signal obtenue lorsque ladite quelconque unité photovoltaïque diffuse, et l'unité photovoltaïque comprend un dispositif de commande (2) et au moins un module photovoltaïque (1) ;
caractérisé en ce que l'appareil comprend en outre :

un premier module de détermination (12), configuré pour déterminer une séquence d'installation de toutes les unités photovoltaïques sur la base d'informations de caractéristique de signal de toutes les unités photovoltaïques ; et
un deuxième module de détermination (13), configuré pour déterminer des informations de position d'installation relative de chaque unité photovoltaïque sur la base d'informations de position d'installation relative d'une unité photovoltaïque cible dans la branche de courant continu à haute tension (4) et de la séquence d'installation de toutes les unités photovoltaïques, dans lequel l'unité photovoltaïque cible est au moins une unité photovoltaïque dans la branche de courant continu à haute tension (4),
dans lequel le premier module de détermination (12) est en outre configuré pour :

déterminer une unité photovoltaïque adjacente à chaque unité photovoltaïque en séquence et sur la base des informations de caractéristique de signal de toutes les unités photovoltaïques ; et
exécuter un séquençage sur la base de l'unité photovoltaïque adjacente à chaque unité photovoltaïque et d'un identifiant de communication de chaque unité photovoltaïque, pour obtenir la séquence d'installation de toutes les unités photovoltaïques,
dans lequel les unités photovoltaïques adjacentes à l'unité photovoltaïque sont deux unités photovoltaïques ayant les plus fortes caractéristiques de signal.

9. Appareil selon la revendication 8, dans lequel la caractéristique de signal est une caractéristique de signal obtenue lorsqu'une quelconque unité photovoltaïque dans la branche de courant continu à haute tension (4) communique avec l'onduleur (3), et le premier module d'obtention (11) est configuré pour :

communiquer avec chaque unité photovoltaïque dans la branche de courant continu à haute tension (4) en séquence ;
envoyer une demande de positionnement à chaque unité photovoltaïque dans la branche de courant continu à haute tension (4) en séquence ; et
recevoir les informations de caractéristique de signal envoyées par chaque unité photovoltaïque après que chaque unité photovoltaïque reçoit la demande de positionnement.

10. Appareil selon la revendication 8, dans lequel la caractéristique de signal est une caractéristique de signal obtenue lorsqu'une quelconque unité photovoltaïque dans la branche de courant continu à haute tension (4) communique avec l'onduleur (3), et le premier module d'obtention (11) est configuré pour :

communiquer avec chaque unité photovoltaïque dans la branche de courant continu à haute tension (4) en séquence ;
diffuser une demande de positionnement à chaque unité photovoltaïque dans la branche de courant continu à haute tension (4) ; et
recevoir les informations de caractéristique de signal envoyées par chaque unité photovoltaïque.

11. Appareil selon l'une quelconque des revendications 8 à 10, dans lequel le premier module d'obtention (11) est en outre configuré pour :
obtenir les informations de position d'installation relative de l'unité photovoltaïque cible dans la branche de courant continu à haute tension (4).

12. Appareil selon la revendication 11, dans lequel le premier module d'obtention (11) est configuré pour :

communiquer avec l'unité photovoltaïque cible sous une première condition, dans lequel la première condition est l'une quelconque de la déconnexion d'un interrupteur d'entrée de courant continu de l'onduleur (3), la déconnexion d'une électrode positive de la branche de courant continu à haute tension (4), et la déconnexion d'une électrode négative de la branche de courant continu à haute tension (4) ; et
déterminer les informations de position d'installation relative de l'unité photovoltaïque cible sur la base d'une caractéristique de signal reçue de l'unité photovoltaïque cible ; ou
déterminer les informations de position d'installation relative de l'unité photovoltaïque cible sur la base d'une caractéristique de signal de l'unité photovoltaïque cible qui est reçue avant l'exécution de la première condition et d'une caractéristique de signal de l'unité photovoltaïque cible qui est reçue après l'exécution de la première condition.

13. Appareil selon l'une quelconque des revendications 8 à 10, dans lequel les informations de position d'installation relative de l'unité photovoltaïque cible dans la branche de courant continu à haute tension (4) sont préstockées dans l'onduleur (3).

14. Appareil selon la revendication 8, dans lequel l'appareil comprend en outre :

un second module d'obtention (14), configuré pour obtenir des informations de caractéristique de signal de chaque unité photovoltaïque dans un système de production d'énergie photovoltaïque solaire, dans lequel les informations de caractéristique de signal d'une unité photovoltaïque comprennent un identifiant de communication de l'unité photovoltaïque et une caractéristique de signal d'une autre unité photovoltaïque, et la caractéristique de signal est une caractéristique de signal obtenue lorsqu'une quelconque unité photovoltaïque dans

le système de production d'énergie photovoltaïque solaire communique avec l'onduleur (3) ou une unité photovoltaïque dans le système de production d'énergie photovoltaïque solaire, ou une caractéristique de signal obtenue lorsque ladite quelconque unité photovoltaïque diffuse ; et

un troisième module de détermination (15), configuré pour déterminer, sur la base d'informations de caractéristique de signal de toutes les unités photovoltaïques et en fonction d'une règle de groupage, une quantité de branches de courant continu à haute tension (4) comprises dans le système de production d'énergie photovoltaïque solaire et une branche de courant continu à haute tension (4) à laquelle appartient chaque unité photovoltaïque, dans lequel la règle de groupage consiste en ce que des unités photovoltaïques adjacentes à une unité photovoltaïque dans une même branche de courant continu à haute tension (4) peuvent être déterminées sur la base des informations de caractéristique de signal des unités photovoltaïques.

15. Dispositif (200), comprenant :

un processeur (202) ; et

une mémoire (201) configurée pour stocker des instructions exécutables du processeur (202), dans lequel le processeur (202) est configuré pour exécuter, en exécutant les instructions exécutables, le procédé d'obtention d'informations de position d'un dispositif de commande (2) selon l'une quelconque des revendications 1 à 7.

16. Support de stockage lisible, dans lequel le support de stockage lisible stocke des instructions exécutables, et lorsqu'au moins un processeur (202) d'un dispositif (200) exécute les instructions exécutables, le dispositif (200) exécute le procédé d'obtention d'informations de position d'un dispositif de commande (2) selon l'une quelconque des revendications 1 à 7.

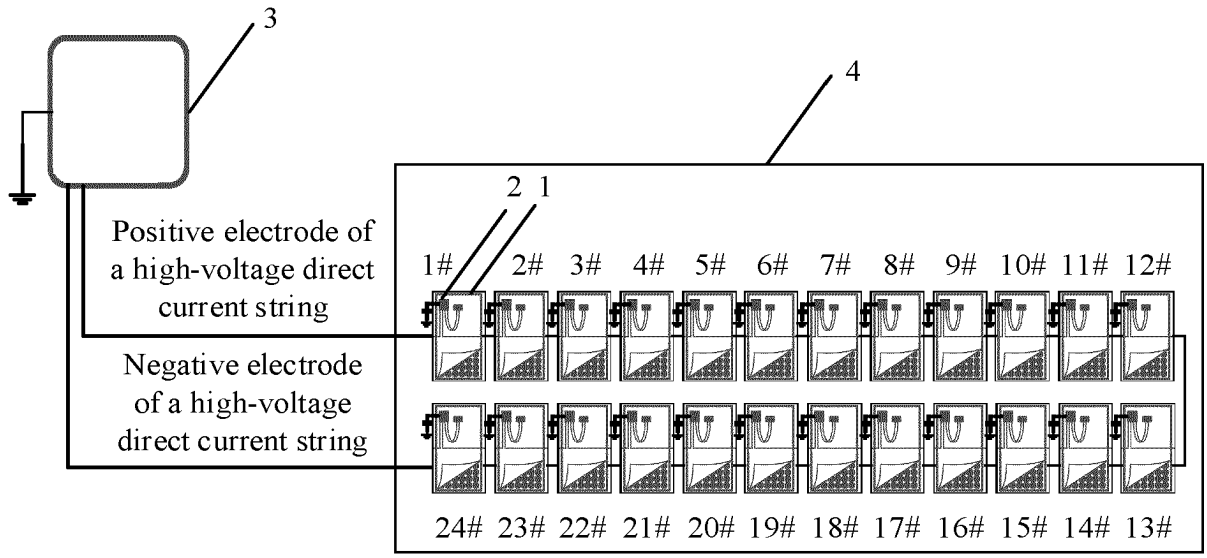
3
4
2 1
Positive electrode of a high-voltage direct current string
Negative electrode of a high-voltage direct current string
1# 2# 3# 4# 5# 6# 7# 8# 9# 10# 11# 12#
24# 23# 22# 21# 20# 19# 18# 17# 16# 15# 14# 13#

FIG. 1

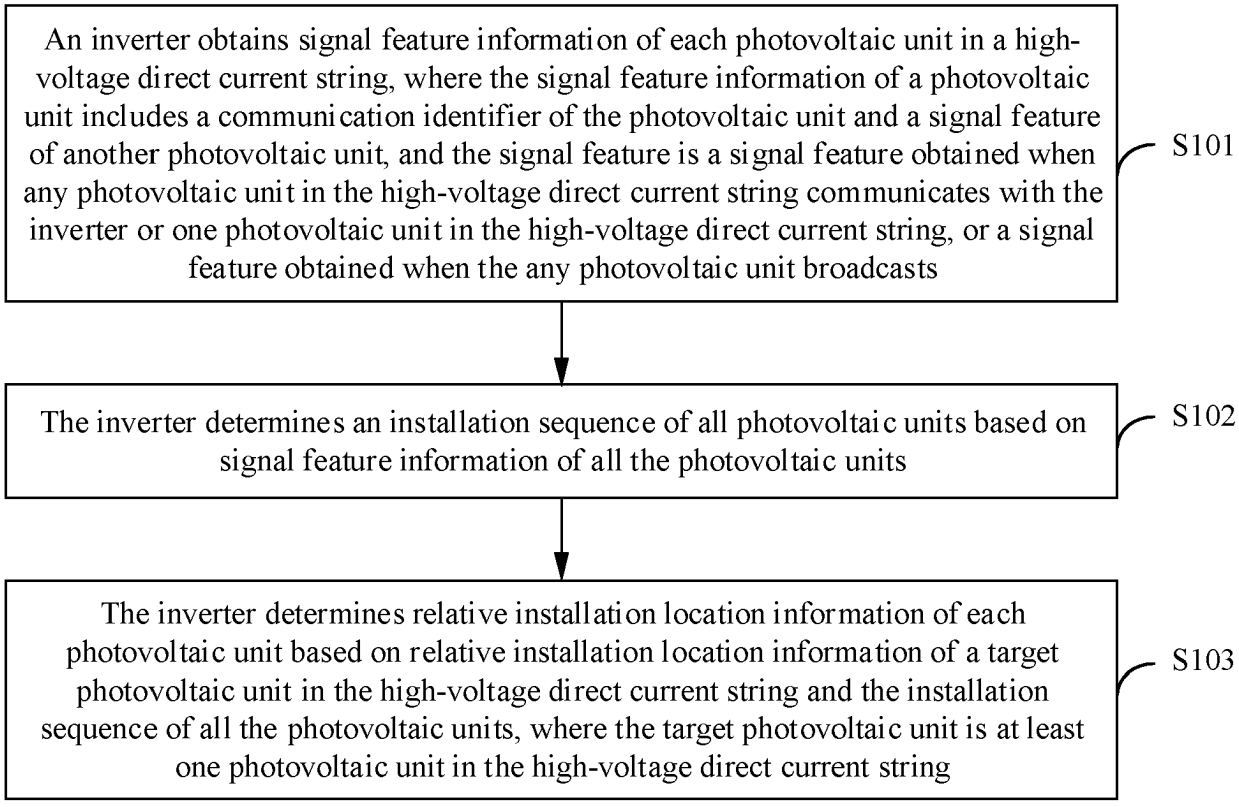
An inverter obtains signal feature information of each photovoltaic unit in a high-voltage direct current string, where the signal feature information of a photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature of another photovoltaic unit, and the signal feature is a signal feature obtained when any photovoltaic unit in the high-voltage direct current string communicates with the inverter or one photovoltaic unit in the high-voltage direct current string, or a signal feature obtained when the any photovoltaic unit broadcasts
S101
The inverter determines an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units
S102
The inverter determines relative installation location information of each photovoltaic unit based on relative installation location information of a target photovoltaic unit in the high-voltage direct current string and the installation sequence of all the photovoltaic units, where the target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string
S103

FIG. 2

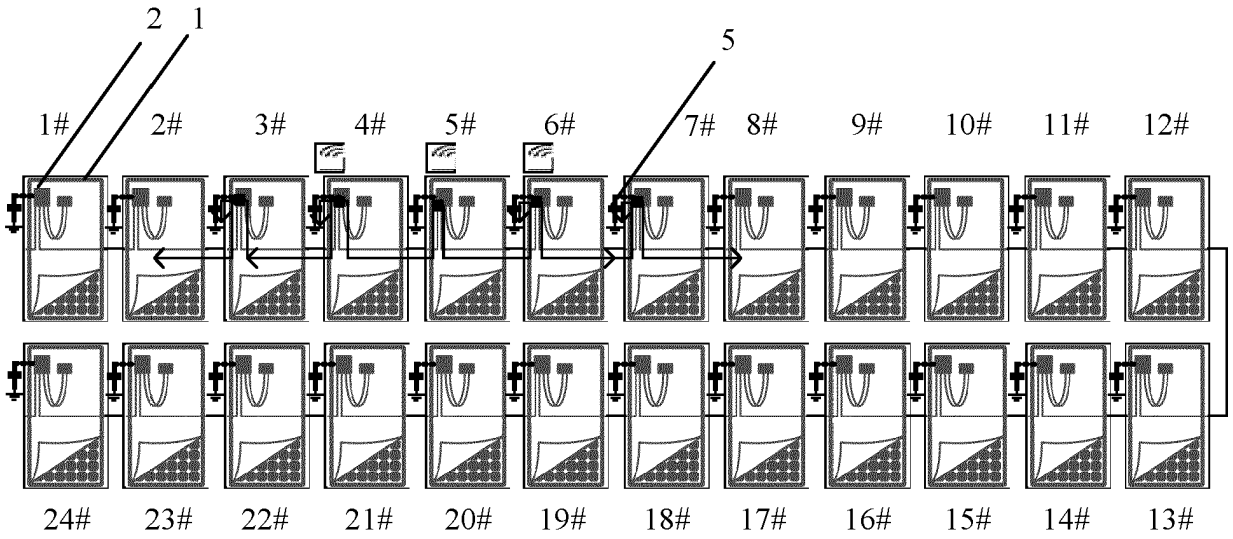
2
1
5
1#
2#
3#
4#
5#
6#
7#
8#
9#
10#
11#
12#
24#
23#
22#
21#
20#
19#
18#
17#
16#
15#
14#
13#

FIG. 3

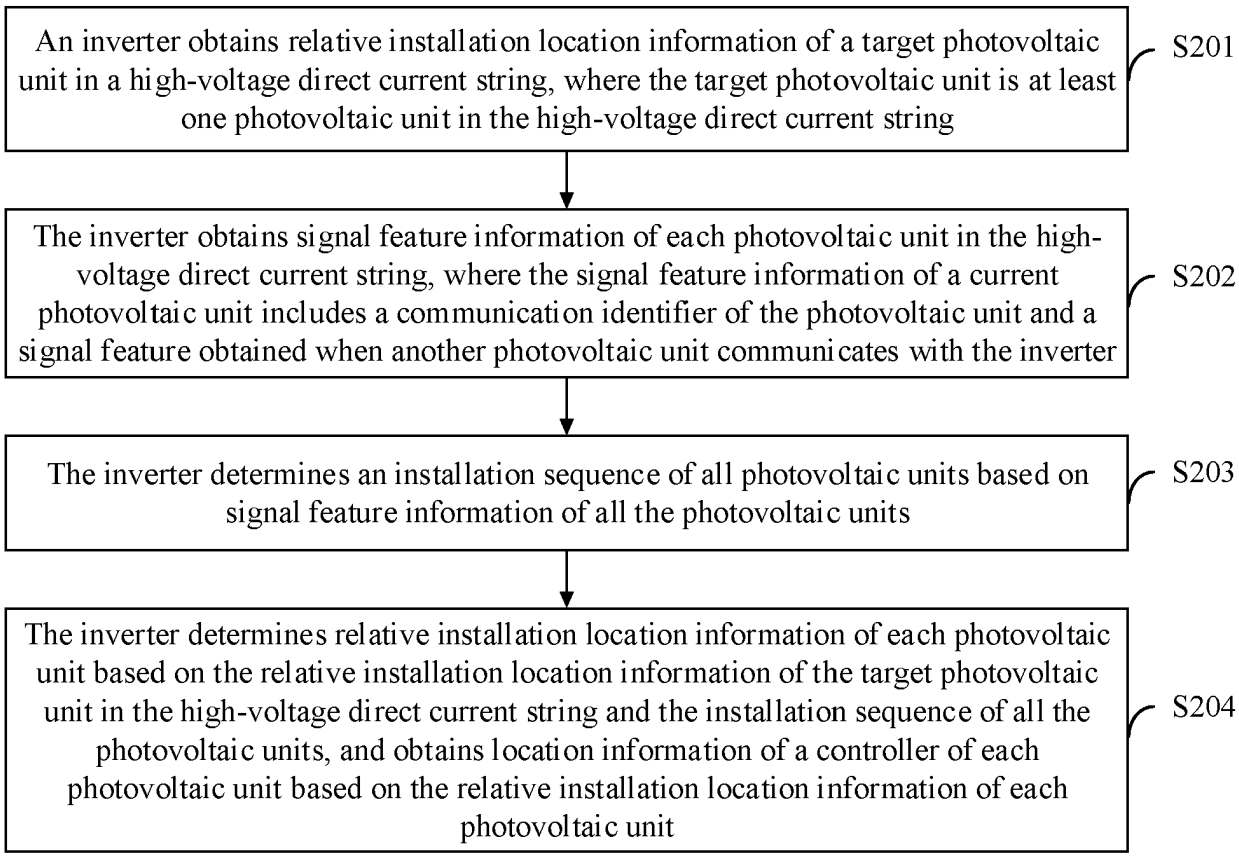
An inverter obtains relative installation location information of a target photovoltaic unit in a high-voltage direct current string, where the target photovoltaic unit is at least one photovoltaic unit in the high-voltage direct current string
S201
The inverter obtains signal feature information of each photovoltaic unit in the high-voltage direct current string, where the signal feature information of a current photovoltaic unit includes a communication identifier of the photovoltaic unit and a signal feature obtained when another photovoltaic unit communicates with the inverter
S202
The inverter determines an installation sequence of all photovoltaic units based on signal feature information of all the photovoltaic units
S203
The inverter determines relative installation location information of each photovoltaic unit based on the relative installation location information of the target photovoltaic unit in the high-voltage direct current string and the installation sequence of all the photovoltaic units, and obtains location information of a controller of each photovoltaic unit based on the relative installation location information of each photovoltaic unit
S204

FIG. 4

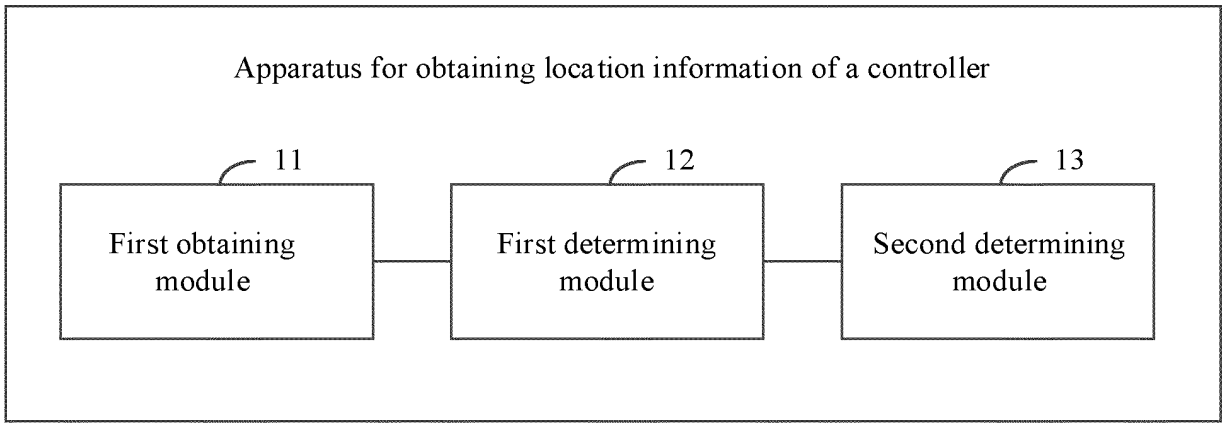

FIG. 5

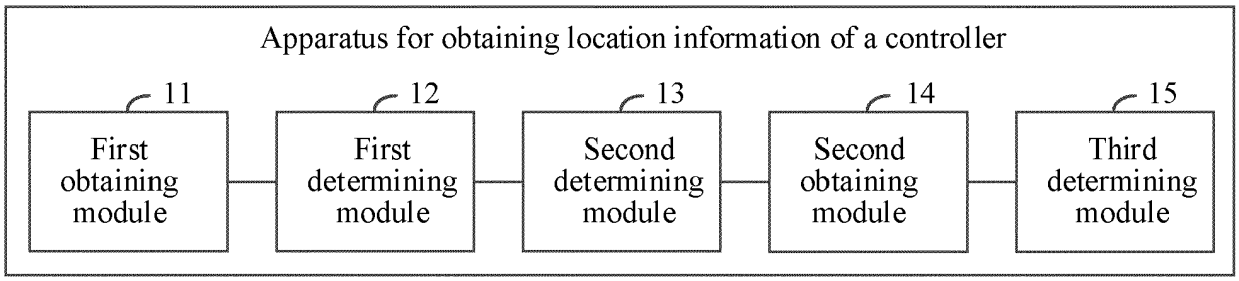

FIG. 6

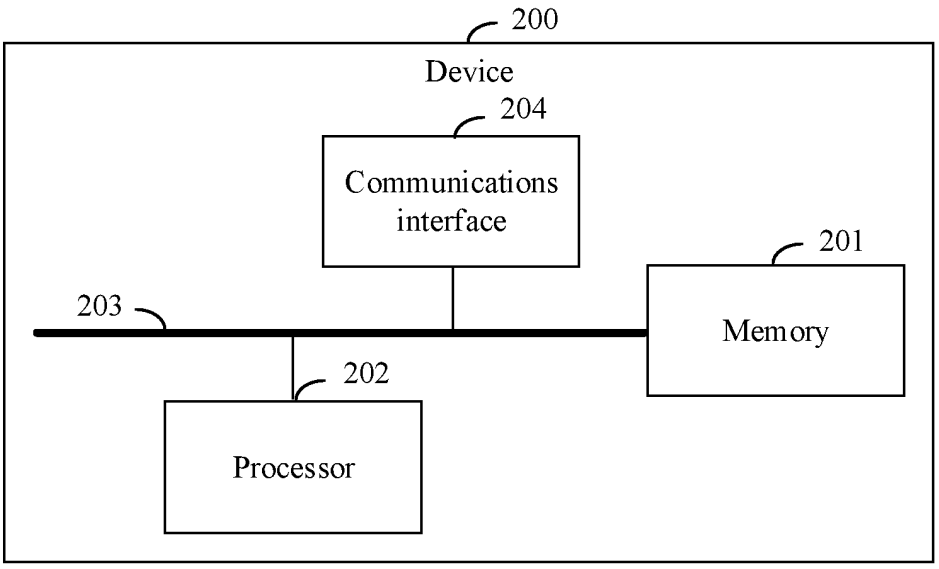

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20130342389 A1 **[0004]**
- US 20060162772 A1 **[0004]**
- US 20170070051 A1 **[0004]**